United Nations E/2001/13

Economic and Social Council

Distr.: General
30 May 2001

Original: English

Substantive session of 2001
Geneva, 2-27 July 2001
Item 10 of the provisional agenda*
Regional cooperation

Summary of the economic and social situation in Africa, 2000

1. The present document is based on the Economic Commission for Africa's *Economic Report on Africa 2001*, and reviews the economic and social conditions prevalent in Africa in 2000. It focuses first on the economic performance of the continent and its subregions for the year 2000. This is followed by the theme of this year's report: The challenge of sustainable development and poverty reduction.

Economic and social conditions in Africa 2000

2. The economy of Africa grew at an estimated 3.5 per cent in 2000, an improvement over the previous year's performance of 3.2 per cent. Sub-Saharan African countries grew at 3.3 per cent in 2000. However, despite the salutary performance of recent years, Africa has yet to attain and sustain the high growth momentum capable of reducing absolute poverty by half. Africa's annual average economic growth of 2.3 per cent during the last decade of the twentieth century did not keep pace with the yearly increase with population growth of 2.8 per cent, and was considerably lower than the 7 per cent annual growth required to reduce poverty by half by the year 2015. The slow growth of the African economy presents the biggest challenge to improving the living conditions of the majority of the African population.

3. There was wide variation in the performance of African economies at the national and subregional levels and among economic groupings. The median growth rate for the region as a whole declined from 4 per cent in 1999 to 2.8 per cent in 2000. In North Africa the median growth rate for the seven countries increased from the 2.6 per cent of 1999 to 3.8 per cent in 2000, while the average growth rate increased from 2.6 per cent to 4.1 per cent, respectively. Growth in sub-Saharan Africa was relatively modest, increasing from 3 per cent to 3.1 per cent, while the median growth fell from 4.1 per cent to 2.5 per cent.

* E/2001/100.

01-39753 (E) 030701

4. The difference between the average and median measures of performance reveals the uneven growth among the subregions, economic groupings and countries. Growth declined in 35 countries, increased in 16 and was the same in 2 others in 2000 relative to 1999. Of the 46 countries in sub-Saharan Africa, growth declined in 32, increased in 12 and was the same in 2.

5. In sharp contrast to the experience of recent years, only one country (Zimbabwe) posted negative GDP growth in 2000. Furthermore, no economy grew at a rate of less than 1 per cent. In 21 countries the growth rates ranged between 1 per cent and 2.9 per cent, while another 15 countries managed to grow in the 3 per cent to 4.9 per cent range. Nine countries had growth rates between 5 per cent and 6.9 per cent. Only two (Equatorial Guinea and the Libyan Arab Jamahiriya), as opposed to five countries in the previous year (Equatorial Guinea, Guinea-Bissau, Rwanda, Botswana, Mozambique) grew at or higher than 7 per cent in 2000.

6. At the subregional level, performance was positive in three and regressed in two regions. In east Africa, which accounts for 31 per cent of the population and 8 per cent of the region's GDP, growth declined from 4.1 per cent in 1999 to 3 per cent in 2000, while the median fell from 3 per cent to 2 per cent, respectively. The highest rate of growth for the subregion was 5 per cent (Ethiopia) while the lowest was 1 per cent (Burundi, Comoros and Kenya). North Africa, which accounts for 22 per cent of the region's population and contributes 41 per cent to the continental GDP, boosted its growth from 2.6 per cent in 1999 to 4.1 per cent in 2000. In southern Africa, where 29 per cent of the region's GDP is produced and 31 per cent of its population reside, growth doubled to 3 per cent mainly due to the strong resurgence of the South African economy. West Africa, accounting for 17 per cent of Africa's GDP and 29 per cent of its population, saw its growth decline from a robust 3.7 per cent in 1999 to 2.8 per cent in 2000, mainly on account of the slow-down in Ghana and the below-average performance in Côte d'Ivoire. Economic performance improved in Central Africa, which contributes 5 per cent to the region's GDP and accounts for 4 per cent of the population, with growth increasing from 4 per cent to 4.5 per cent.

7. The five largest economies in Africa, i.e., the African G-5 (Algeria, Egypt, Morocco, Nigeria and South Africa), which account for 59 per cent of GDP and 37 per cent of the population of the region, posted a growth rate of 3.2 per cent in the year under review, compared to 2.8 per cent in 1999. The 11 oil-exporting African economies, which account for 49 per cent of the region's GDP and 41 per cent of the population, managed to push their growth to 4.4 per cent from 3.8 per cent in 1999 because of higher oil revenue.

8. The six island-economies, making up about 2 per cent of the region's GDP and population, managed to increase their growth rate to 4.7 per cent from 4 per cent in 1999. The African least developed countries (LDCs), representing 16.5 per cent of the GDP and 47 per cent of the population, saw their growth shrink from 4.5 per cent in 1999 to 3.5 per cent in 2000. The 15 land-locked countries (10 per cent of the regional GDP and 23 per cent of the population) were the hardest hit, with growth declining from 4.9 per cent in 1999 to 2.9 per cent in 2000.

9. At the sectoral level, there was significant recovery in agriculture, which posted a growth rate of 3.6 per cent in 2000 compared to 2.1 per cent in 1999. The industrial sector was also on a positive trend, particularly in the oil-exporting and North African countries. This sector grew by 3.4 per cent compared to 2.8 per cent

in the previous year. The service sector continued to enjoy buoyant growth, increasing by 1 percentage point to reach 4 per cent in 2000.

10. Despite the welcome recovery in agriculture, the region remains far short of satisfying its food needs. Africa will continue to depend on external assistance to make up for the gap between domestic supply and demand for the nearly 20 million people who face critical food shortages.

11. On the macroeconomic front, inflation measured 11 per cent, exceeding the 1999 level by 1 percentage point. This is attributable to the improvement in agricultural output in many countries, which kept prices stable. Price rises in the oil-exporting countries were much more pronounced, with consumer prices increasing by 15 per cent.

12. On the external front, United States-dollar-denominated world prices for the region's exportables were mixed. Average oil prices increased by more than 57 per cent over their 1999 level. On the other hand, prices of food and beverages declined while those for agricultural raw materials slightly increased. Beverage prices were the hardest hit with prices falling by more than 16 per cent relative to 1999. The aggregate price for the region's exportables increased by 20 per cent.

13. Export volume of African countries increased by 8 per cent while import volume rose by 5 per cent. Export earnings increased by nearly 30 per cent to $131 billion as a result of increases in prices and volume. The increase in the price of oil, which accounts for 60 per cent of the region's export earnings, was the main factor behind the surge in foreign exchange receipts.

14. United States-dollar-denominated prices of the region's imports increased by 4 per cent. As a result, the terms of trade for the region increased by about 16 per cent. However, the terms of trade of the non-oil-exporting countries deteriorated by 21 per cent owing mainly to higher oil prices, increased prices of the region's imports and declining prices for their exports.

15. The balance of trade registered export earnings of $131 billion in 2000, 30 per cent higher than in 1999. The value of imports is estimated at $117 billion. As a result of developments in exports and imports, the current-account balance improved considerably, registering a $5.7 in surplus.

16. However, the balance on current account of the non-oil-exporting countries further deteriorated. The trade balance was in deficit by $23 billion and the current account by $48 billion. External resource flows rose from $22 billion in 1999 to $23 billion. Foreign direct investment amounted to about $6 billion while $8 billion came in as transfers. Borrowing amounted to $9 billion, an increase of nearly 13 per cent over 1999. The volume of debt declined to $342 billion relative to the $359 billion in 1999. Debt servicing increased from $39.4 billion in 1999 to $43.4 billion in 2000.

17. There has been slight progress in poverty reduction worldwide with the share of population living on less than $1 a day falling from 28 per cent in 1987 to 23 per cent in 1998, even though the number of poor remained roughly constant, as the population increased. In Africa, however, the population living on less than $1 per day has sharply increased from 217 million in 1987 to 301 million in 1998. Africa is now the region with the largest share of people living below $1 a day. The average income of the poor for the continent as a whole is only 83 cents per person per day.

In sub-Saharan Africa 52 per cent of people live on less than $1 a day (in 1995 dollars adjusted for purchasing price parity). In 2000 the average monthly expenditure was only $13 by the rural poor (down from $14 in 1999) and $27 by the urban poor. That leaves 59 per cent of rural people below the poverty line and 43 per cent of urban. The level of poverty is moderate in the North African countries, where only 22 per cent of their population are below the poverty line; the corresponding figure for sub-Saharan Africa is 51 per cent.

18. Africa has the worst income distribution in the world, with a Gini coefficient of 51 per cent (0 per cent is perfect equality, 100 per cent perfect inequality). The mean share of the lowest 40 per cent of the rural population is only 16 per cent of total expenditure, a shortfall of 24 percentage points, while the mean share of the top 20 per cent is about 48 per cent, an excess of 28 points over perfect equality. Similarly, the mean share of the lowest 40 per cent of the urban population is only 15 per cent of total expenditure, a shortfall of 25 percentage points of total income. The mean share of the top 20 per cent of the population is about 50 per cent, an excess of 30 points.

19. The health status of the continent declined largely due to the ravages of the HIV/AIDS epidemic; 25 million people, including over 1 million children, were living with HIV/AIDS. At least 5 million people were newly infected with the virus in 2000. In Botswana, Namibia, Zambia and Zimbabwe, between 20 and 27 per cent of people aged between 15 and 50 are infected. In 12 other African countries, including Ethiopia, Kenya, Mozambique, South Africa and the United Republic of Tanzania, 9 to 20 per cent of adults are infected. Some countries in West and Central Africa have been less affected and have been able to maintain low and stable HIV/AIDS infection rates. Senegal is an excellent example. It is estimated that deaths due to HIV/AIDS in Africa will soon surpass 21 million.

20. Some indication of how quickly the epidemic has spread out of control in Africa can be gleaned from the following statistics: Uganda was the only African country with an HIV prevalence rate of higher than 2 per cent in 1982. Today, there are over 20 countries in Africa with a prevalence rate of 7-10 per cent or more. In urban antenatal women in Blantyre, Malawi, the prevalence rate increased from less than 5 per cent in 1985 to over 30 per cent in 1997. The corresponding figure from Francistown, Botswana, was 43 per cent in 1997 from less than 10 per cent in 1991. In Ethiopia, the proportion of adults infected with HIV increased from less than 1 per cent in 1987 to nearly 10 per cent in 1997.

The challenge of sustainable development with poverty reduction

21. Africa faces the critical challenge in the twenty-first century of reducing widespread poverty while conserving the rich biodiversity and reducing environmental degradation. Worldwide concerns about the environment have increased owing to the pace at which mankind is using up natural resources and the failure to develop safe means to dispose of the waste. Global warming due to emissions of greenhouse gases and the depletion of the ozone layer is advancing at an alarming rate. Non-renewable resources are being run down, biological species are being destroyed while soil degradation grows at an alarming pace.

22. Sustainable development involves multidimensional and complex interactions between human beings and their ecosystem. As a point of departure, the United

Nations definition of sustainability as that which "meets the needs of the present without compromising the needs of the future generation" is adopted in the Report. This approach requires a comprehensive and holistic framework to articulate needs, and generate effective strategies and efficient policies, covering a broad range of interactive determinants, including demographic dynamics, social and economic conditions and natural resource endowments.

23. Sustainable development is a long-term interactive process that embodies:

(a) Environmental sustainability

Environmental sustainability will ensure Earth's natural wealth. To do this, we must: (i) maintain the integrity of ecosystems and the continued health of the planet's life-support system — which sustain the productivity, adaptability of renewal of all life; (ii) maintain biological diversity in the variety of life on which ecological processes depend — processes that provide a stream of current and future benefits to human beings; and (iii) ensure sustainable population dynamics (size of population, growth rate and distribution), as it often exerts pressures on the environment.

(b) Economic sustainability

Economic sustainability implies policy choices leading to pro-poor, broad-based economic growth and development over the long term. Economic sustainability requires action on four fronts: (i) macroeconomic policy measures; (ii) efficient resource allocation at the sectoral level to effect economic transformation, (iii) more equitable access to resources, and (iv) enhancing the opportunities of the poor.

(c) Capable States

Sustainable development is unlikely, if not impossible, where the State is ineffective and mired in conflicts. Development is unthinkable in an environment of war or widespread political violence, or where people's rights and freedoms are heavily constrained. Political sustainability requires social consensus about acceptable ways of resolving conflict, the rights and responsibilities of citizens, and the appropriate role of the State, including the military.

There is greater awareness and recognition today among the African countries and their development partners that governance systems have to evolve towards more participatory, open, transparent, accountable and efficient decision-making modalities in order to support and promote sustainable development.

Indicators of sustainable development

24. The *Economic Report on Africa 2001* presents indicators of sustainable development. Three dimensions of sustainability are identified — economic, environmental and institutional. The three should not be viewed as independent of each other. They are closely linked, and efforts to promote any one of them must take explicit account of the implications for the others. Sustainable development can be only reached if development efforts respect all three. Viewing sustainable

development this way increases understanding of how economic, environmental and institutional systems interact.

Environmental sustainability index

25. As discussed above (see para. 23), in order to achieve environmental sustainability, it is necessary to: (a) maintain the integrity of ecosystems and the continued health of the planet's life-support systems, which sustain the productivity, adaptability and renewal of all life; (b) maintain biological diversity in the variety of life on which ecological processes depend — processes that provide a stream of current and future benefits to humans; and (c) ensure sustainable population dynamics (size of population, growth rate and distribution), as population often puts pressures on the environment.

Components of the index include:

- Environmental quality — water quality/quantity, biodiversity, air quality;
- Environmental stress — pollution, consumption and waste, deforestation, and population;
- Environmental protection.

Economic sustainability index

26. Economic sustainability implies, as described above (see para. 23), policy choices leading to broad-based economic growth and development over the long term. Growth is not a good in itself but is valuable as a means for advancing human well-being — so economic sustainability should be seen in the context of other policy priorities, including institution-building and sound environmental management.

27. Economic sustainability requires action on four fronts: (a) macroeconomic policy measures and structural adjustment; (b) efficient resource allocation at the sectoral level; (c) more equitable access to resources, including improving income distribution and striving for gender equity; and (d) increasing the productivity of the poor, partly through investments in basic health and education.

28. The report provides a modified version of the Economic Sustainability Index. Components of the index include:

- Income/wealth, consumption, savings, and investment — levels and changes (pace, regularity, and volatility) including poverty and inequality;
- Human capital — education and health (level and changes including inequality);
- Factor productivity;
- Infrastructure.

Indicators of the capable State

29. That institutions matter is no longer in doubt. The Report 2001 focuses on institutions which pertain to the development of a market-based economy and the management of civil conflict. The Report provides indicators of a Government's capacity to formulate and implement policies and the respec of citizens and the

State for its institutions. The following six component indices of the capable State are measured for selected African countries:

- Access to information and accountability;
- Government effectiveness;
- Political stability;
- Rule of law;
- Control of corruption.

The environmental challenge

30. Africa is the victim of both endogenous and exogenous factors of environmental degradation. Despite the fact that the region contributes the least to the emission of greenhouse gases (1.1 metric tons per capita per annum), owing to its low per capita consumption of fossil fuel, it is the most vulnerable to climatic changes. Vulnerability of the rural sector is most acute, given its high dependence on rain-fed agriculture and because of widespread poverty, which limits capacity to effectively respond and adapt to the changing circumstances. Although it is notoriously difficult to predict climatic changes in the years ahead, temperatures are expected to increase at the rate of 0.2° C per decade over the next 50 years. Rainfall is projected to decline by 10 per cent in southern Africa and the Horn, and fall by 15 per cent in the Sahel by 2050. The sea level is projected to rise by 25 cm, which is expected to impose additional constraints, mainly on island economies.

31. The quality and capacity of the soil to support productive agriculture is critical to sustainable development. Unfortunately, the larger proportion of the African soils have characteristics that render them not very productive. In addition to extensive and intensive use in the past, most soils are either very old (the laterites), awfully leached, and of low fertility. Soil regeneration is a slow process and is likely to lag behind vegetation and climatic changes. Fire and land use have been identified as factors influencing the soil-water mix, and the turnover of organic matter. Land use and forest fires are among the more critical factors. Changes in the intensity and frequency of forest fire regimes will determine the soil nutrient mix and influence its productivity.

32. Climatic changes and land management practices lead to land degradation and eventually to desertification. Land degradation, defined as "a reduction in the capability of the land to support a particular use" is a major problem in Africa where 66 per cent is dryland and 73 per cent of the agricultural drylands are already degraded. Land degradation is manifested in, among others, soil erosion, soil contamination, loss of organic matter, nutrient depletion, acidification, and salinization. Low rainfall, long dry spells, recurrent droughts, sparse vegetation, are among factors contributing to the region's desertification.

33. Deforestation, which is estimated to vary between 0.52 per cent and 0.7 per cent per annum is one of the major causes for land degradation and soil erosion in Africa. Rates of deforestation in West Africa and in Madagascar are high and are likely to lead to nearly complete deforestation in these areas. Logging for lumber, long considered a primary cause of deforestation, has been a major factor in West Africa. Initially one of the most densely forested countries in West Africa, Côte

d'Ivoire, in the absence of controls, lost 290,000 hectares of forest per year in the first half of the 1980s. This was equal to 10 per cent of the total closed area in the country. In West Africa today, only about 15 per cent of the original tropical moist forest remains. Africa lost 39 million hectares of tropical forest during the 1980s, and another 10 million hectares by 1995 (ADB 1997).

34. The devastating effect of plant pests and diseases in Africa is reflected in the amount spent by farmers on their control. In Kenya in 1995, for instance, farmers purchased 1.36 million kg of insecticides, 1.7 million kg of herbicides and 3.3 million kg of fungicides. These represent a very significant amount of crop production cost (Republic of Kenya 1996). Huge crop losses are incurred in Africa as a result of pre- and post-harvest pest and disease damage. The issue of pest and disease resistance in crops is, therefore, of crucial significance to African farmers.

35. Water is also becoming an issue of serious concern. There is fear that future regional conflicts may result from competition over water use. Partly owing to long spells of drought, Africa has less water today than in the 1970s. For instance, the Congo basin, which incorporates one of the largest river systems in the world, has witnessed a significant reduction in water resources. Associated with water supply is the issue of water pollution. In rural areas, the population draws water from unprotected areas, such as wells and rivers. Many of these sources have been exposed to serious pollutants from the infiltration of agricultural chemicals and fertilizer, and raw sewage.

36. A recent study, *Pilot Analysis of Global Ecosystems* reveals that in Africa:

- Soil degradation, including nutrient depletion, erosion, and salinization is widespread;
- Irrigation is draining more water than is being replenished by rainfall, causing water tables to fall;
- Agriculture consumes over 50 per cent of the freshwater withdrawn annually; also, many water resources are being polluted by extensive use of fertilizers and pesticides; and substantial forest areas are being converted into agriculture, resulting in extensive species and habitat loss. In fact, agriculture is encroaching on many national parks and other protected areas.

Modernized agriculture is the key to sustainable development

37. Africa's agriculture will for a long time continue to play a leading role in generating incomes for the majority, providing food and industrial inputs, and producing the bulk of exports. Therefore any credible attempt to reduce poverty, conserve biodiversity and reduce environmental degradation needs to focus on this sector. Among the constraints facing efforts to regenerate agriculture is the continuously declining farm size, the depletion of soil fertility and the consequential low productivity, backward technology and climatic variability.

38. The fact that African agricultural development has been held back over the last 30 years is often attributed to immediately recognizable adverse conditions, such as the low population density, the proneness to drought and disease, and civil strife. Furthermore, a legacy of poor public interventions in input and product markets has not yet been entirely reversed.

39. Although Africa is reputed to be an underpopulated continent, it has the second lowest per capita cropland at 0.28 hectares compared to Asia's 0.16 hectares. This compares unfavourably to the 1.8 hectares per capita of 1960. The relative crowding of the rural milieu and the resulting diminution of farm size is due to failure to develop an alternative income-generating activity, making agriculture the reservoir to accommodate the growing labour force. Of the population engaged in agriculture, 60 per cent accounts for only 19 per cent of GDP, which is indicative of the abysmally low productivity of the labour force engaged in the sector.

40. High fertility rates are considered to have contributed to stagnation in average yields. There is a general impression that Africa is a land-abundant continent; however, conditions for cultivation in several areas are not ideal. Much of idle land is actually of low quality and unsuitable for production owing to erratic rainfall. Fallow land may not actually be surplus land and opportunity costs may also be associated with cultivation. Finally, several areas are suffering from the effect of tsetse flies, river blindness, and other illnesses. There are concerns about the success of national agricultural systems in the development of crops suitable for fragile soils. The inability of current varieties to absorb a higher ratio of fertilizers halts the transition of African agriculture to more intensive forms of cultivation. Low yields act as a disincentive for capital investment. Previous studies have shown very weak effects of mechanization in productivity increases.

41. Africa's rapid population growth rate of about 3.0 per cent per annum is greater than the increase in food production of 2.5 per cent per annum. This calls for new ways of improving and sustaining food production to move in tandem with the population growth rate. Agricultural development is in all cases a critical factor for the economic development of most countries in the continent. The fast demographic growth in African countries will therefore push back agricultural frontiers in many regions, and will increase intersectoral competition for the use of scarce resources.

42. It is estimated that during this decade, less than 5 per cent of increase in food production will emanate from crop area expansion while some 10 per cent will originate from additional irrigation. The overwhelming balance of over 80 per cent will come from increased productivity per unit of land.

43. For instance, although African conditions are ideal for cereal production, the continent still remains a net cereal importer. In 1998, for instance, sub-Saharan Africa alone accounted for 36 per cent of global food deliveries, compared with only 11 per cent for Latin America and the Caribbean. Chronic food shortages have led to serious undernourishment among broad sections of the population and to stunting among children. While cereal yields in Asia and Latin America have risen since the mid-1960s, following the introduction of high-yielding varieties, those in Africa have remained stagnant or declined. In 1993-1995, for instance, average yields in Africa were over 40 per cent lower than in Asia and Latin America. By 1996-1998, they were below 50 per cent.

44. Past increases in agricultural productivity resulted from an expansion of land under cultivation but today such land is in short supply, if at all available. Hence, intensive techniques provide the best hope for increased production of the principal food crops in Africa. Comprehensive studies on African rainfall have shown a progressive drying trend, with drought a common occurrence over large parts of the continent. The frequent droughts in Africa have often been blamed on human agricultural activity, particularly overgrazing and deforestation. The fact remains

that agricultural growth is also severely constrained by extensive and severe rainfall shortage. Therefore, development of crops and livestock breeds that are early-maturing is needed, with higher productivity and that are adaptable to harsh climatic conditions of Africa.

Harnessing crop biotechnology for poverty reduction and sustainable development

45. The Report notes that agriculture in Africa will be confronted with three major challenges in the decades to come:

- To increase the availability of nutritious food to an increasing population;
- To use the natural ecosystems (including marginal land) more effectively, efficiently environmentally sustainable in food production; and
- To make a contribution to the overall economic development and poverty reduction.

46. Harnessing crop biotechnology is an important avenue to achieve these goals.

Green Revolution I

47. The first phase of the Green Revolution, or GR I, in Africa and most of the Asian countries (1960-1975) consisted of the introduction of varieties of wheat, rice and maize, fundamentally focused on raising yields of open-pollinated seeds. These varieties were selected to be responsive to high intake of fertilizers under irrigation. Because they were highly susceptible to pest infestation, they required extensive spraying of chemicals. Hence, the new varieties were mostly adopted by farmers in the best-endowed regions, with good market integration, easy access to credit, and sufficient ability to bear risks.

48. Significant improvements in yields were recorded in these crops as to give rise to the term "Green Revolution". These were mainly among large- and medium-scale farmers in Asia and to some extent in Africa, e.g., in Kenya, Zimbabwe and South Africa. Nonetheless, after the early euphoria with the GR I, a host of problems became evident: the need for a significant use of agro-chemical-based pest and weed control raised both environmental concerns and human health concerns; as irrigation areas expanded, water management required skills that were not always available and there were new scientific challenges to be tackled. Furthermore, lack of appropriate technology remained a constraint for many farmers, especially smallholder farmers, in areas with unfavourable conditions.

Green Revolution II

49. The second phase of the Green Revolution, or GR II, (1975-to date) sought to consolidate the extent of these yield gains by diversifying research in the pursuit of a wider range of traits desirable for the less well-endowed areas for the smallholder farmers. Continued gains were sought by increasing the productivity of factor use, rather than applying high doses of chemicals and water. To this end, the number of high-yielding varieties of a particular crop was broadened to extend the geographical applicability to specific ecosystems and raise spatial genetic diversity. New traits included resistance to pests and diseases and tolerance to stress. This

allowed reduced variance to yields. The area of applicability was extended towards rainfed and marginal regions, e.g., in the Sahel region of West Africa and some parts of East and southern Africa. The range of crops was also widely broadened towards crops suited for marginal environments and consumed by people in tropical and semi-tropical environments, such as pearl millet, sorghum and cassava. In this regard, the quest for traits additional to yields, in particular traits desirable for poor farmers and improved farm management, was the hallmark of the GR II revolution. As a consequence, direct effects on poverty were significantly enhanced.

50. Both the GR I and II were public-sector research generated via public institutions and international institutes; e.g., the International Agricultural Research Centres (IARCs) partially sponsored by the Consultative Group on International Agricultural Research (CGIAR). CGIAR research has borne considerable fruit:

- The adoption of new plant varieties, agricultural know-how, and technology developed at CGIAR research centres have all been crucial in the increasing grain harvests in most developing countries during the past three decades;
- Of the wheat varieties planted in developing countries, 80 per cent have come from the International Maize and Wheat Improvement Centre (CIMMYT), a CGIAR centre in Mexico, with the additional output to high yield worth nearly $2 billion a year;
- Scientists at the International Rice Research Institute (IRRI) and the West African Rice Development Association (WARDA), the other CGIAR centres, crossed African and Asian rice varieties applying tissue culture techniques to develop a strain that is both hardy and has exceptionally broad leaves, thereby providing biological weed resistance; this not only improves rice harvest in West Africa, but has reduced the time women rice farmers have to spend weeding, allowing them to spend more time in caring activities that are essential for good child nutrition; and
- Other CGIAR centres have helped West and Central African maize production to increase threefold between 1981-96, enough to feed an additional 40 million people a year, at a value of $1.2 billion.

51. The 1998 report on the Third System Review of CGIAR stated that "investment in the CGIAR has been the single most effective use of official development assistance (ODA). ... There can be no long-term agenda for eradicating poverty, ending hunger, and ensuring sustainable food security without the CGIAR."

Gene Revolution

52. The third phase is the Gene Revolution, GeneR, or Biotechnological Revolution, as it has popularly come to be known. The genesis of biotechnology offers the possibility of further amplifying the achievements realized by traditional breeding for a number of reasons, which include, inter alia:

- Diagnostic kits for identification of plant and animal pathogens;
- Quickening of the pace of research via the use of selectable gene markers, promoters, and new scanning devices; and
- Expanding the spectrum of potential products and traits via genetic engineering (GE) (recombinant deoxyribonucleic acid (DNA) techniques,

insertion of genetic materials) of plants and animals; wide crossing (transfers of genes from wild relatives of the crop) and transfers of foreign genes.

53. The potential of biotechnology to reduce poverty calls for careful identification of the main features of agro-biotechnology research that can have direct and indirect effects on poverty: what crops, what traits, and for what environment? These are some of the key questions that the genetic modification (GM) biotechnology must address.

54. Some African countries are in the process of producing GM, or transgenic crops. In others, namely in Kenya, success stories have been reported where biotechnology approaches have, to a greater extent, contributed to the solution of specific problems among the smallholder farmers. The ongoing GM crop research and transgenic crops grown in some selected African countries is discussed below.

Some definitions of biotechnology and its component technologies

Biotechnology is any technique that uses living organisms or substances from those organisms to make or modify a product, improve plants or animals or develop micro-organisms for specific uses. Biotechnology, therefore, deals with the utilization of biological processes in technical operations and production. Genetic engineering is a means to an end, inasmuch as it allows the properties of micro-organisms to be modified in such a way that a desired effect is brought about in biological processes, among others. Biotechnologies can be divided into the traditional areas of fermentation for the production of potable beverages and foodstuffs, and the modern biotechnologies, which include the production and use of organisms, which have been GM for the large-scale production of single-cell proteins or proteins. The major components of modern biotechnology are:

- Genomics: the molecular characterization of all species.
- Bioinformatics: the assembly of data from genomic analysis into accessible forms.
- Transformation: the general process of moving genes between species. The result is a transgenic organism. Lately, transgenic organisms have come to be known as GMOs.
- Genetic modification: the direct introduction of desirable characteristics by the artificial transfer of foreign or synthetic DNA into plants. DNA is the biochemical substance from which the genetic material is made.
- Molecular breeding: the identification and evaluation of desirable traits in breeding programmes by the use of marker-assisted selection, for plants, livestock and trees.
- Diagnostics: the use of molecular characterization to provide more accurate and rapid identification of pathogens and other organisms.
- Vaccine technology: the use of modern immunology to develop recombinant DNA (rDNA) vaccines for improving control of lethal diseases.

- Plant tissue culture: a technique used for the growth of undifferentiated plant cells in vitro. The regeneration of entire organisms from single cells, to both preserve genetic resources and produce disease-free planting materials.

Sources: Coombs (1992), Persley and Doyle (1999), and Qaim (1999).

Ongoing genetic engineering plant research at the Agricultural Genetic Engineering Research Institute (AGERI), Egypt (wheat, maize, faba bean, potato, tomato, date palm, banana, cucurbits and cotton)

55. The Egyptian Government has a strong desire to improve its agricultural sector performance. This sector contributes to the overall food needs of the country's 67 million people. Arable land makes a mere 3 per cent of the total land area, while the area under irrigation constitutes some 99 per cent of cropland. Agriculture accounts for 36 per cent of the total labour force, and both 20 per cent of GDP and total exports. Strategic goals of the Egyptian agricultural sector are (a) optimizing crop returns per unit of land and water consumed; (b) enhancing sustainability of resource-use patterns and protection of the environment; and (c) bridging the food gap and attaining food self-reliance.

56. One of the major targets for genetic engineering biotechnology in Egypt is to produce transgenic plants conferring resistance to biotic stress resulting from pathogenic viruses, bacteria, fungi, and insect pest, and abiotic stresses, such as salinity, drought and high temperature. These biotic and abiotic stresses are major agricultural problems leading to serious yield and post-harvest losses in many economically important crops in the country, particularly the ones named above.

57. Established in 1990 as a public sector institution, AGERI aims at promoting safer transfer and use of this technology. The Institute attaches a high priority to collaborating with the private sector, which will be fully kept abreast of the research and development in genetic engineering and biotechnology in Egypt via: (a) circulation of newsletter and research reports; (b) representation of the private sector in the design of product research and development; and (c) representation of the private sector on the AGERI governing board. AGERI has further initiated partnership with Pioneer Hi-Bred, a United States private company in Iowa State, through a USAID research and development arrangement to achieve, among others, the following:

1. Research and training for AGERI scientists at Pioneer Hi-Bred/Iowa in designing and implementing safety regulations, laboratory safety procedures, and field testing procedures for GMOs; and

2. Increase the potential for product development.

58. Recently, the Institute successfully manufactured its first bio-pesticides — Agerin — based on the insecticidal bacterium Bacillus thuringiensis (Bt). Agerin is capable of protecting a broad range of key agricultural commodities, and controlling a number of biomedically significant pests. Field trials of GM potatoes containing tuber moth-resistant were conducted in 1996, and in 1997 the trials for virus-resistant tomatoes and cucurbits. The trials were part of collaboration programme

between the AGERI and the Agricultural Biotechnology for Sustainable Productivity (ABSP).

59. To fulfil its commitments to bring research results into application by a large number of farmers, the Institute in collaboration with a private investor has succeeded in setting-up a commercial entity "BIOGRO International". It is envisaged that BIOGRO will be responsible for, inter alia, the free flow of information and the genetically modified crops produced by the Institute for commercialization.

60. As the leading biotechnology research institutions in North Africa and the Middle East, AGERI plans to share its technical know-how with other countries within the framework of technical cooperation among developing countries. This is expected to materialize via specialized seminars/workshops and regular internships.

Transgenic crops grown in South Africa (maize, potato, strawberries and cotton)

61. South Africa is among a host of developing countries with a unique set of problems that beg for the adoption of modern biotechnology to increase agricultural output. South African farmers, most of whom are smallholders, have not benefited from the recent advances of biotechnology and a number of constraints still persist. The country has less than 15 per cent of arable land and a high population growth rate has placed high demand for more food, particularly proteins. Most small-scale farmers remain poor, obtaining their livelihoods from marginal lands; this has triggered massive rural-urban migration. There is further evidence of increasing damage to the agricultural ecological base, e.g., land, water, forests, and biodiversity, among others. The end result has been unprecedented poverty among a large section of the population.

62. In this regard, considerable work has been done on GM maize, potato, strawberries and cotton, and the issue of integrated pest management. In fact, the above-named ranges of crops are expected to expand to include more food crops. Field trials with GM crops have been taking place since the early-1990s. The first commercial releases of GM varieties were in 1997, and commercial planting of crops with insect-resistant and herbicide-tolerant traits started in 1998. Studies in the Makatini Flats in the Kwazulu-Natal province in 1998 showed a 20 per cent yield increase in cotton through the use of insect-resistant GM cotton seed. In cases of some commercial farmers, operators were able to forgo pesticide spraying completely. Drought-tolerant research is making tremendous progress in South Africa. The private sector is quite active in GM biotechnology, and has been doing this without government involvement. The public sector attitude is understood at the political level as being in support of good science, responsible behaviour and access to quality information.

63. On a cautionary note, however, it has come to light that the GM debate in South Africa needs to balance the interests of the private sector, the farmers, the consumers; but those interests are not always in harmony. There is a high cost of technology development and transfer. It is not simply an issue of developing a technology and then giving it to farmers to adopt. Risk assessment and management techniques must be in place to support the introduction of the genetically modified organisms (GMOs), and to deal with conflicts of interest that may emerge, particularly from environmental and consumer groups.

64. In view of the above, the Government of South Africa has instituted a range of measures aimed at correcting the negative impact of poverty and harnessing the benefits of technological advances. It is for this particular reason that, for instance, the Genetically Modified Organisms Act (Act No. 15 of 1997) was promulgated and implemented in December 1999 with the objective of promoting responsible development, production, use and application of GMOs. To achieve this, the Act aims at protecting the environment and human health through risk assessment and management of each one of the GMOs. All the GMOs are evaluated under this Act on the basis of sound science for human health and environmental safety as well as socio-economic implications.

65. Nonetheless, the stark reality is that currently, very few African countries have the human and institutional capacities to manage risks and win consumers' confidence that these products carry no health and environmental risks. This is a core issue that African countries will have to grapple with before any of the GM crops are commercially released for sale to farmers.

Banana tissue culture biotechnology (Kenya, Morocco and South Africa)

66. Banana, a perennial crop, is both food and fruit in several African countries. The crop is grown in various agro-ecological zones. Constraints to increase its production include, among others, devastating diseases and pests such as Panama disease and black sigatoka (both caused by fungi), banana weevil, and lack of disease resistant banana varieties. The resulting yield losses make banana a relatively expensive commodity for consumers, and reduce cash earnings of producers as well as the potential of the crop to contribute to the food security of rural households. The situation is essentially the same in most African countries. Average banana yield in Kenya is about 14 tons per hectare; less than 30 per cent of the crop's potential under the favourable conditions of the humid tropics.

An example from Kenya of banana tissue culture biotechnology

> "The [banana tissue culture biotechnology] project was formally launched in Kenya in the mid-1997 with a primary aim of contributing to improved quality of life for rural families in the central province of Kenya. The project seeks to positively impact on the lives of resource-poor and small-scale farmers in Kenya in general by increasing the availability of banana both as food and through sales of fruits in the local market — modest income."

67. Banana tissue culture rapid multiplication has been successfully commercialized in Morocco, Kenya and South Africa. Tissue culture banana is free of pests and diseases. In Kenya, for instance, the Kenya Agricultural Research Institute (KARI) has already conducted on-station experiments and on-farm field trials with tissue culture material in the central province of Kenya. In the coming years, the technology is to be disseminated country-wide. The potential effects of banana tissue culture technology at the farm level have also been calculated. KARI itself does not have the capacity to produce enough of the country-wide tissue culture plantlets. To this end, explicit involvement of the private sector in the multiplication and dissemination of this technology is regarded as an important strategy to minimize the need for external financial support in the long run.

68. To be able to quantify the potential agronomic effects of tissue culture banana biotechnology, 25 national and international banana researchers were consulted. In

addition, interviews were conducted with 46 farmers and 10 local agricultural extension officers in the major growing provinces to learn more about banana farming practices and constraints.

69. For the analysis of distributional effects, the banana farmers were subdivided into three groups — small-scale farmers with less than 0.2 hectares, medium-scale farmers with between 0.2 hectares and 0.8 hectares and large-scale farmers with above 0.8 hectares.

70. Cost and income calculations of the current banana production practices have been done for each group (without tissue culture). The evidence shows that adopting tissue culture could bring about a substantial yield increase in all three farm types. In relative terms, the potential gains are most pronounced in smallholders. Using in vitro plantlets not only raises the yields but is also associated with additional costs. Nonetheless, the rising revenue offsets additional costs. Through adopting this innovation, the smallholders could raise their banana income by 156 per cent, whereas income gains for the larger farms would be 93 per cent.

71. One could argue, however, that remarkable income increases could be achieved without biotechnology, simply by applying more inputs and improving the banana cultivation habits. Yet the potential of an appropriately introduced technological innovation to bring a modernization of farming systems should not be underestimated. These findings support the idea that biotechnology can be particularly beneficial for small-scale agricultural producers, who are often suffering from the biggest crop pre- and post-harvest losses caused by biotic and abiotic stress.

72. The move towards commercialization of the crop is under way. An initiative to extend the banana biotechnology project to the neighbouring countries has also been started by KARI and the International Service for the Acquisition of Agro-biotech Applications (ISAAA) in collaboration with national research organizations in Uganda and the United Republic of Tanzania. In the long run, genetically engineered bananas with durable resistance to major pests and diseases might be even more beneficial than the tissue culture for smallholders. There is also an ongoing project at KARI to develop transgenic cp-gene resistant sweet potatoes for Africa.

73. The Kenyan example of banana tissue culture basically demonstrates two things: (a) the potential gains of appropriate biotechnology products can be greatest for the small-scale farmers; and (b) more public research and development funds should be made available to develop biotechnologies that explicitly tackle the needs of resource-poor producers in Africa. The actual impact of biotechnology is not only a question of technological peculiarities, but also hinges on an efficient institutional framework. The successful use of biotechnology, therefore, presupposes extensive capacity-building in the national system of agricultural research and technology diffusion.

74. Overall, therefore, the above analyses of the ongoing development of modern crop biotechnology in some African countries demonstrate the major efforts by the private and public development programmes to establish research facilities that can produce GMOs in the national territory. Nonetheless, much more needs to be done before the GM crops are commercially released in the markets for sale and also before the benefits can be fully realized by both the farmers and consumers alike. The subsequent sections are devoted to the analyses of these kinds of issues.

Policy choice framework for biotech adoption in African countries

Strengths	*Weaknesses*
• Rich in biological diversity • A growing scientific knowledge about the GM biotechnology • Strong partnership between NARS and the CGIAR	• Low investments in public sector agricultural research • Weak scientific expertise to track and map global trends of biotechnology • Weak capacity of the region to participate effectively in the international debate on protocol of biosafety, technology transfer, licensing, etc. • Inadequate public participation in the GM biotechnology debate
Opportunities	*Threats*
• Increased crop yields • Reduced chemical use (e.g., pesticides and herbicides) • Less toxic herbicide run-off to surface and groundwater • Reduced farmer exposure to chemicals • Reduced farm input costs • Increased incomes • Enhanced nutritional quality of foods • Reduced pre- and post-harvest food losses, longer storage life • Minimal exploitation of forests, grasslands, marginal lands, and swamplands for food crops — preservation of biodiversity • Broadening range of crops towards those suited for marginal areas and consumed by poor people in tropical/semi-tropical areas, e.g., pearl millet, sorghum, and cassava	• New allergens • Antibiotic resistance • New viruses • New weeds • Terminator gene prevents reproduction of seed, increasing cash cost • Few private sector monopoly on GM biotechnology research • Lack of scientific and financial support of GMO research from countries where such technology is prohibited • Trade ban on GM export products • Aggravation of the prosperity gap between North and South • Exploitation of natural genetic resources without appropriate compensation • Unresolved matters pertaining to intellectual property rights

75. The *Economic Report on Africa 2001* notes that GM biotechnology has the potential to generate substantial benefits to African farmers and consumers.

However, it cautions that the ongoing public opposition in several industrial countries is likely to persist until pertinent questions regarding the safety of GM crops for people, animals and the environment are resolved.

76. Concerns are wide ranging: (a) consumers' concerns about the immediate and long-term safety of GM foods on human beings; (b) concerns about environmental effects, including risks in the reduction of biological diversity, increasing out-crossing or proliferation of superbugs, gene leakage and the sustainable agriculture using GM seeds; and (c) social, ethical, religious, economic and other societal concerns stemming from the possible impact of the GM crops on the society at large.

77. The Report provides a menu of strategies and interventions that are required. These include, among others: (a) a massive scaling-up of poverty-focused public sector GM research for developing countries; (b) strengthening the role of civil society participation in the GM crop biotechnology debate; (c) regional collaboration in the biotechnology research activities with a view to adapting such biotechnology to cater to farmers' needs; (d) promoting international collaboration in GM crop and animal research; (e) squarely addressing issues pertaining to intellectual property rights.